

(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開2001-47161

(P2001-47161A)

(43) 公開日 平成13年2月20日 (2001.2.20)

(51) Int. Cl.<sup>7</sup>

B 2 1 D 39/20

識別記号

F 1

B 2 1 D 39/20

シーシー (参考)

A

審査請求 未請求 請求項の数 7 O L (全 4 頁)

(21) 出願番号

特願平11-228876

(22) 出願日

平成11年8月12日 (1999.8.12)

(71) 出願人 000003713

大同特殊鋼株式会社

愛知県名古屋市中区錦一丁目11番18号

(72) 発明者 冷水 幸夫

愛知県名古屋市天白区表山二丁目311番地

八事サンハイツ501

(72) 発明者 堀尾 浩次

愛知県東海市加木屋町南鹿持18番地

(72) 発明者 鬼頭 一成

愛知県名古屋市緑区古鳴海2-38

(74) 代理人 100070161

弁理士 須賀 総夫

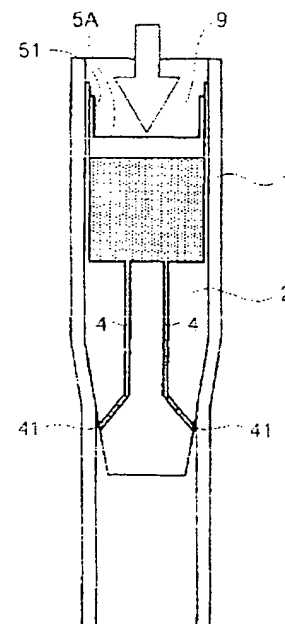
最終頁に続く

(54) 【発明の名称】 金属管の拡張方法および拡張工具

(57) 【要約】

【課題】 金属管 (1) の一端部に砲弾型の拡張工具 (2) を入込し、流体内の流体 (3) の圧力をかけ、前進させることにより管の内径を拡大することからなる拡張技術において、管径より十分以上に及ぶ長さの金属管の拡張を可能にする方法および拡張工具を提供すること。

【解決手段】 内部に潤滑剤 (4) を有し、この潤滑剤で、管の底面、延伸する内部の側面に潤滑剤 (4) を塗布し、延伸する内部の側面に潤滑剤 (4) を塗布するとともに、流体の圧力を受けて潤滑剤 (4) が潤滑剤に付着する圧力伝達手段 (5) を有する拡張工具 (2) を使用し、拡張工具 (2) を管 (1) の一端部に挿入し、管 (1) の内部に潤滑剤 (4) を連続的に供給し、管 (1) の内径を拡大させる。



BEST AVAILABLE COPY

体は外力を受けてタンク内の潤滑剤に伝わる手段を設け、拡張工具(2)の前進に伴って潤滑剤(S)を拡張工具(2)の管内壁に供給するように構成したことを特徴とする。

【0010】潤滑剤の導管(4)が開口するノズル(41)と拡張工具(2)のチーバ面上の位置は、図2に示したように、金属管と拡張工具とが接触する直前のあたりで適切であって、この位置において潤滑剤が吐出されることにより、金属管の内壁への潤滑剤の確実な適用が可能になり、拡張作業の円滑さが保証される。

【0011】流体の圧力を受けてタンク内の潤滑剤に伝わる圧力伝達手段の一例は、図2に示したような、タンク内から流体に接する面に設けた、落とし蓋形状を有し、その咽喉から立ち上がる円筒状の部分(51)がタンクの内壁に密着して上下することのできる有底筒状体(5A)である。製作および使用の容易さの点で、この装置はとくに好適である。

【0012】圧力伝達手段の別の例は、上記した板の円筒状部分を、図3に示すように、板の周縁に設けたシール(52)に替えた板(5B)である。この構造を採用するときは、板が傾かないように、適宜のガイド手段を設けるとよい。

【0013】さらに別の例は、圧力伝達手段として、図1に示したような、タンクの圧力流体に接する面を覆うゴム製のダイヤフラム(5C)を使用するものである。このダイヤフラムは、ゴム、プラスチックなどで製造することができる。

【0014】本発明に拡張工具の変形態様は、図4に示すように、工具の後方に開口して軒方向に延びる水の導管(6)を設け、その先端を、潤滑剤導管の開口部より前方に位置し、拡張する管の内壁に向かって洗浄水を噴射させるためのノズル(61)として開口させたものである。

拡張工具	図1	図2	図3	図4	図5
水の圧力 最大値	500	300	320	290	250
水の圧力 平均値	280	230	230	230	210
母材破断比率	-	10/19	19/19	19/19	19/19

【0015】

【発明の効果】本発明により、施工は著しく困難ないし不可能であった長尺の金属管を連続的に拡張する作業が、円滑に実施できるようになった。従って本発明は、腐蝕した配管により管径を増大させることがとくに望まれる、製油と石油の前記した油井・ガス井で用いる各種チーバ、吸管に適用したとき、その意義が大きい。そのほか、石油精製、石油化学、ゴム事業、各種化学工業およびハイテク工業などの分野で本発明を適用して効果を得る。

【図面の簡単な説明】

【図1】従来技術による金属管の拡張作業を示す、管と拡張工具との縦断面図。

【図2】本発明による金属管の拡張作業の一例を示す、管と拡張工具との縦断面図。

【図3】本発明による拡張工具の別の例を示す、管と拡張工具との縦断面図。

【0014】

【実施例】高压配管用炭素鋼管「STS410」(JIS G3455、外径139、8mm、肉厚6.6mm、長さ6m)を20本、アーク溶接によりつなぎ合わせて、全長120mとしたものを、5本用意した。これらの長尺の鋼管を、それぞれ図1ないし図5に示した構造の拡張工具(いずれも拡張率が20%となるように設計・製作したもの)を使用して拡張した。

【0015】潤滑剤としては、グリースに二硫化モリブデン粉末を、混合物の65重量%を占めるように混練したものを使用した。拡張工具の表面にも、同じ潤滑剤を塗布した。比較のため、従来技術(図1の拡張工具)による実験も行なった。この場合は、溶接に先立って、各鋼管の内面に両端から500mmの長さを残して潤滑剤を塗布しておいた。

【0016】上記の長尺鋼管を固定し、その一端に拡張工具を油圧ピストンで押し込んでから密閉し、密閉空間にポンプで水を圧入することにより拡張工具を前進させ、拡張を行なった。その間、ポンプで圧入した水の圧力を測定した。比較例は、拡張の途中で工具が停止したが、なお水の圧力を高めていったところ、溶接箇所の手前の母材部分で破断してしまった。

【0017】拡張後、溶接部分の途中で切断し、長さが6mの管19本に分けた。アムスラ式万能試験機(2000t)にかけて引張試験を行ない、破断が生じる箇所が溶接部であるか母材であるかを調べた。その結果を、水の圧力とともに、下の表にまとめて示す。

【0018】

図2	図3	図4	図5
300	320	290	250
230	230	230	210
10/19	19/19	19/19	19/19

す、図1に対応する管と拡張工具との縦断面図。

【図3】本発明による拡張工具の別の例を示す、管と拡張工具との縦断面図。

【図4】本発明による拡張工具のさらに別の例を示す、管と拡張工具との縦断面図。

【図5】本発明による拡張工具のなおも別の例を示す、管と拡張工具との縦断面図。

【符号の説明】

- 1 金属管
- 2 拡張工具
- 3 潤滑剤のタンク

4 潤滑剤の導管

41 ノズル

5A 有底筒状体(圧力伝達手段)

41 潤滑剤

51 円筒状

51 円筒状

© EPDOC/EPO

PN - JP2001047161 A 20010220  
 PD - 2001-02-20  
 PR - JP19990228876 19990812  
 OPD- 1999-08-12  
 TI - TUBE EXPANDING METHOD OF METAL TUBE AND TUBE EXPANDING TOOL  
 IN - INAGAKI SHIGEYUKI;KITO KAZUNARI;HIYAMIZU TAKAO;HORIO KOJI;YAMADA RYUZO  
 PA - DAIDO STEEL CO LTD  
 EC - E21B43/10F ; E21B43/10F1  
 IC - B21D39/20

© WPI/DERWENT

TI - Metallic tube expansion method for oil wells, involves supplying lubricant through tube before expansion by expanding tool  
 PR - JP19990228876 19990812  
 PN - JP2001047161 A 20010220 DW200126 B21D39/20 004pp  
 PA - (DAIZ ) DAIDO TOKUSHUKO KK  
 IC - B21D39/20  
 AB - JP2001047161 NOVELTY - The method involves supplying the lubricant through the metallic tube (1), before expansion by the expansion tool (2).  
 - DETAILED DESCRIPTION - The common ball type expansion tool (2) is inserted into the metallic tube (1). The internal diameter of the tube is expanded by the pressure of hydrolyic fluid from the rear side of the tool. An INDEPENDENT CLAIM is also included for tube widening tool.  
 - USE - For casing tube, telescopic tube, coiled tubes in oil well, gas well, refinery.  
 - ADVANTAGE - The expansion work is executed smoothly and continuously.  
 - DESCRIPTION OF DRAWING(S) - The figure shows the sectional elevation of tube expansion tool.  
 - Metallic tube 1  
 - Expansion tool 2  
 - (Dwg.2/5)  
 OPD- 1999-08-12  
 AN - 2001-252189 [26]

© PAJ/JPO

PN - JP2001047161 A 20010220  
 PD - 2001-02-20  
 AP - JP19990228876 19990812  
 IN - HIYAMIZU TAKAOHORIO KOJI;KITO KAZUNARI;INAGAKI SHIGEYUKIYAMADA RYUZO  
 PA - DAIDO STEEL CO LTD  
 TI - TUBE EXPANDING METHOD OF METAL TUBE AND TUBE EXPANDING TOOL  
 AB - PROBLEM TO BE SOLVED: To expand a metal tube having a length of several-hundred meters or more in a tube expanding technology by which a bullet shaped tube expanding tool is inserted into the inside of the metal tube, a fluid pressure is applied from rear side and an inner diameter of the tube is expanded by advancing the tool.  
 - SOLUTION: A tube expanding tool, which has a lubricant tank at a rear part, is arranged with a lubricant conduit tube 4 extending from a bottom of the lubricant tank and opening to a tapered face at the front part and is arranged with a pressure transfer means to receive/transfer a fluid pressure to the lubricant in the lubricant tank, is used, the tube expanding tool is advanced while continuously and uniformly supplying the lubricant to a tube inner wall part immediately before tube expanding.  
 I - B21D39/20

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
31 May 2001 (31.05.2001)

PCT

(10) International Publication Number  
WO 01/38693 A1

(51) International Patent Classification<sup>7</sup>: E21B 29/10,  
43/10

(21) International Application Number: PCT/EP00/12024

(22) International Filing Date:  
29 November 2000 (29.11.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
99309532.2 29 November 1999 (29.11.1999) EP

(71) Applicant (for all designated States except US): SHELL  
INTERNATIONALE RESEARCH MAATSCHAPPIJ  
B.V. [NL/NL]; Carel van Bylandtlaan 30, NL-2596 HR  
The Hague (NL).

(72) Inventor; and

(75) Inventor/Applicant (for US only): HEIJNEN, Wilhelmus, Hubertus, Paulus, Maria [—/NL]; Grote Hout of Koningsweg 49, NL-Velsen 1951 GN (NL).

(81) Designated States (national): NO, US.

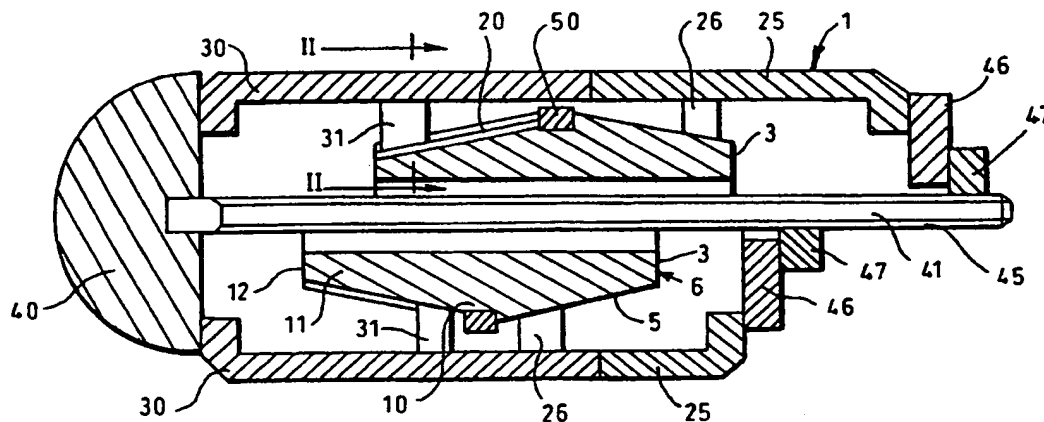
(84) Designated States (regional): European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

- With international search report.
- Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: PIPE EXPANSION DEVICE



(57) Abstract: A device (1) for expanding a pipe comprising a bi-conical sleeve (3) having a first section (5) and a second section (11), which sections (5, 11) are provided with at least two longitudinal guide channels (20), first wedges (25), wherein each first wedge (25) tapers into the direction in which the first section (5) widens and is provided with a support element (26) that co-operates with the corresponding longitudinal guide channel of the first section (5), second wedges (30), wherein each second wedge (30) tapers into the direction in which the second section (11) widens and is provided with a support element (31) that co-operates with the corresponding longitudinal guide channel (20) of the second section (11), and means for moving the wedges (25, 30) into each other.

WO 01/38693 A1

## PIPE EXPANSION DEVICE

The present invention relates to a device for expanding a pipe, such as a casing string or a liner in a borehole. Pipe expansion is done to increase the diameter of a pipe, this is particular relevant to a well completion, wherein a number of casing strings is introduced into a borehole to protect the borehole from collapsing and to contain the well fluids therein. In such a completion each next casing string has a smaller diameter than the preceding one, in order that the next casing string can be put in place. Consequently the cross-section available to fluid flow through the completion becomes smaller and smaller as the number of casing strings increases. And this adversely affects the production from the well. To overcome this the casing strings are expanded so that the overall internal diameter of the well completion is not reduced.

Pipe expansion is achieved by displacing through the pipe an expansion device having a larger diameter than the inner diameter of the pipe. Because the forces exerted on the expansion device during pipe expansion are large, such expansion devices have fixed dimensions. And this implies that the expansion has to be performed in stages.

It is an object of the present invention to provide a device for expanding a pipe to the same diameter as the pipe through which the pipe to be expanded is run. It is a further object of the present invention to provide a device of which outer diameter can easily be adjusted, and that is sufficiently strong to withstand the forces that it subjected to during the pipe expansion.

To this end the device for expanding a pipe according to the present invention comprises a bi-conical sleeve having a first section widening from one end of the bi-conical sleeve to the middle and a second section widening from the opposite end of the bi-conical sleeve to the middle, which sections are provided with at least two longitudinal guide channels which guide channels in the second section are staggered in relation to the guide channels in the first section, a set of first wedges, wherein each first wedge tapers into the direction in which the first section widens and is provided with a support element that co-operates with the corresponding longitudinal guide channel of the first section, a set of second wedges, wherein each second wedge tapers into the direction in which the second section widens and is provided with a support element that co-operates with the corresponding longitudinal guide channel of the second section, and means for moving the sets of wedges into each other.

The invention will now be described by way of example in more detail with reference to the accompanying drawing, wherein

Figure 1 shows schematically a longitudinal section of the device according to the present invention in an initial position and in an expanded position; and

Figure 2 shows a cross-section along line II-II of Figure 1 drawn to a different scale.

Reference is made to the Figures. The device 1 for expanding a pipe (not shown) according to the present invention comprises a bi-conical sleeve 3. The bi-conical sleeve 3 consists of two sections, a first section 5 widening from one end 6 of the bi-conical sleeve 3 to the middle 10 and a second section 11 widening from the opposite end 12 of the bi-conical sleeve 3 to the middle 10.

Each of the sections 5 and 11 is provided with four longitudinal guide channels 20, distributed evenly about the circumference of the sections of the bi-conical sleeve 3. For reasons that will be explained below, the guide channels 20 in the second section 11 are staggered in relation to the guide channels (not shown) in the first section 5.

The device 1 further comprises a set of first wedges 25, wherein each first wedge 25 tapers into the direction in which the first section 5 of the bi-conical sleeve 3 widens. Each of the first wedges 25 is provided with a support element 26 that co-operates with the corresponding longitudinal guide channel of the first section 5.

The device 1 further comprises a set of second wedges 30, wherein each second wedge 30 tapers into the direction in which the second section 11 of the bi-conical sleeve 3 widens. Each of the second wedges is provided with a support element 31 that co-operates with the corresponding longitudinal guide channel 20 of the second section 11.

The reason that the guide channels 20 in the second section 11 are staggered in relation to the guide channels (not shown) in the first section 5, is that the wedges 25 and 30 can slide with respect to each other as the fingers of two hands when the hands are moved into each other.

The device 1 further comprises means for moving the sets of wedges 25 and 30 into each other. These means comprise a front end part 40, a connection rod 41 secured with one end in the front end part 40 and provided at the other end with a screw thread 45. At the other end of the device 1, the means comprise a ring 46 and a nut 47 co-operating with the screw thread 45 on the connection rod 41.

When the device 1 is being put in place in the pipe (not shown) to be expanded, the nut 47 is at the end of the connection rod 41. This position is shown in the upper half of Figure 1. In this running position, the  
5 outer diameter of the device 1 is so that the device 1 can be displaced through the pipe.

In order to expand the pipe, torsion is applied on the nut 47, so that it is rotated in a direction so that the nut 47 moves towards the front end part 40 over the  
10 screw threads. The tapering wedges 25 and 30 are pushed by the ring 46 into each other, and the support elements 26 and 31 move towards each other in the longitudinal guide channels. Because the longitudinal guide channels are parallel to the outer surface of  
15 sections of the bi-conical sleeve 3 in which the guide channels are arranged, the support elements also move outwards in a radial direction. And consequently the wedges 25 and 30 move outwards as well. This expanded position is shown in the lower half of Figure 1.

20 In this expanded position the device 1 can be pushed through the pipe, for example by means fluid pressure exerted on a piston (not shown) that acts on the ring 46.

The tapering wedges 25 and 30 are in contact with each other along their edges. Therefore the tapering  
25 wedges 25 and 30 support each other, and in this way sufficient support is provided so that the device according to the present invention provides sufficient collapse resistance to withstand the forces that it subjected to during the pipe expansion. Moreover, the  
30 outer diameter of the device can easily be adjusted.

To prevent the device 1 from expanding too far, the bi-conical sleeve 4 can be provided with a ring 50 in the middle 10.

By adjusting the nut 47, the diameter can be  
35 adjusted, and this can easily be done without removing



the device from the pipe.

It will be understood that there is a one-to-one relationship between the wedges and the guide channels, because for each tapering wedge there is a guide channel.

5        Suitably the number of guide channels, and consequently wedges is in the range of from 2 to 8, and suitably in the range of from 4 to 6. By selecting the number of wedges, the device according to the present invention can be made is sufficiently strong to withstand  
10       the forces that it subjected to during the pipe expansion.

C L A I M S

1. A device for expanding a pipe, which device comprises a bi-conical sleeve having a first section widening from one end of the bi-conical sleeve to the middle and a second section widening from the opposite end of the bi-conical sleeve to the middle, which sections are provided with at least two longitudinal guide channels which guide channels in the second section are staggered in relation to the guide channels in the first section, a set of first wedges, wherein each first wedge tapers into the direction in which the first section widens and is provided with a support element that co-operates with the corresponding longitudinal guide channel of the first section, a set of second wedges, wherein each second wedge tapers into the direction in which the second section widens and is provided with a support element that co-operates with the corresponding longitudinal guide channel of the second section, and means for moving the sets of wedges into each other.

2. Device according to claim 1, wherein the sections are provided with between two and eight longitudinal guide channels.

Fig. 1.

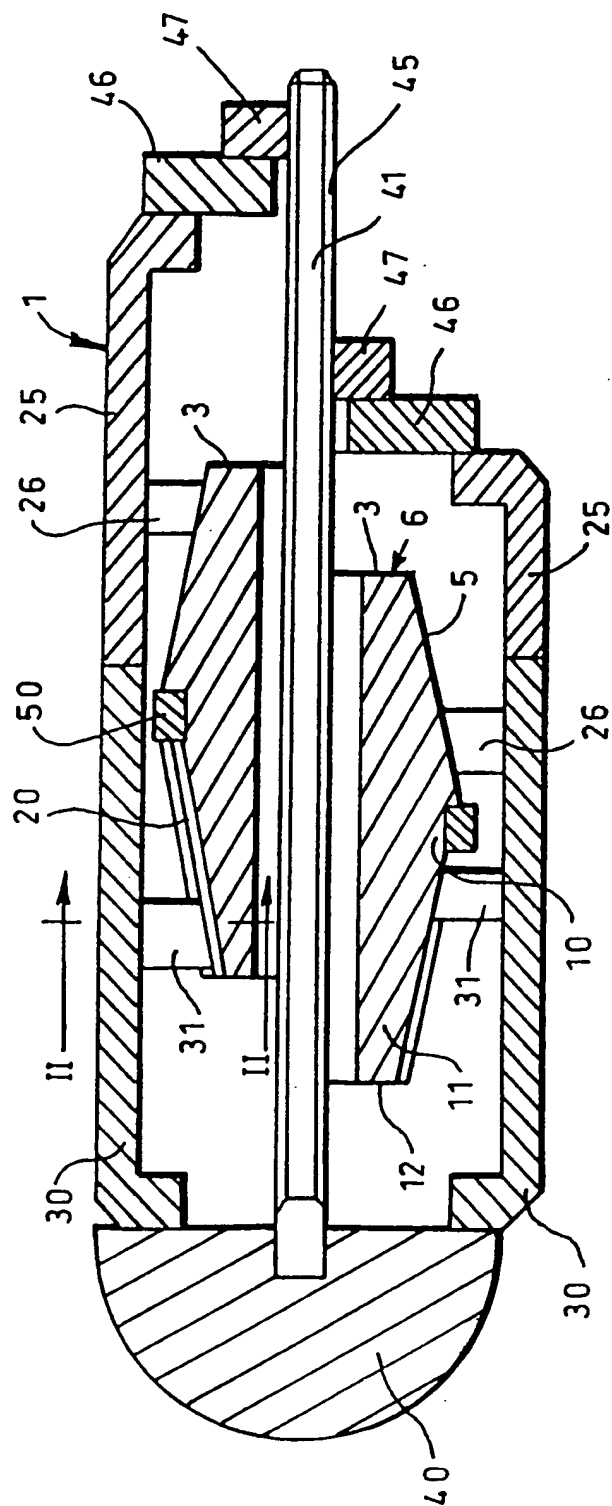
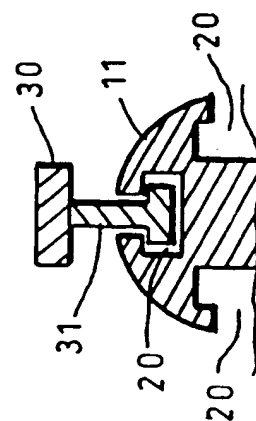


Fig. 2.



# INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 00/12024

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 E21B29/10 E21B43/10

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E21B B21D C21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 146 331 A (YARNELL IAN ROLAND) 26 June 1985 (1985-06-26) abstract; figure 1	1,2
A	EP 0 418 620 A (MASTER IND INC) 27 March 1991 (1991-03-27) abstract; figures 1-3	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

### \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \* & \* document member of the same patent family

Date of the actual completion of the international search

4 April 2001

Date of mailing of the international search report

12/04/2001

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Tompouloglou, C

# INTERNATIONAL SEARCH REPORT

information on patent family members

Inter. Appl. Application No

PCT/EP 00/12024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0146331 A	26-06-1985	AT 27017 T	15-05-1987
		AU 580572 B	19-01-1989
		AU 3680684 A	20-06-1985
		CA 1247869 A	03-01-1989
		DE 3463535 D	11-06-1987
		DK 600184 A, B,	17-06-1985
		FI 844875 A, B,	17-06-1985
		GB 2151325 A, B	17-07-1985
		NO 845012 A, B,	17-06-1985
		US 4789268 A	06-12-1988
		US 4657436 A	14-04-1987
		ZA 8409713 A	28-08-1985
EP 0418620 A	27-03-1991	US 4993755 A	19-02-1991
		AU 625609 B	16-07-1992
		AU 6130090 A	28-03-1991
		CA 2025655 A	23-03-1991
		JP 3121396 A	23-05-1991